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(12) UK Patent Application (19) GB (11) 2 072 302 A

(21) Application No 8108107
(22) Date of filing 16 Mar 1981
(30) Priority data
(31) 8006128
(32) 19 Mar 1980
(33) France (FR)
(43) Application published 30 Sep 1981
(51) INT CL³ F16F 9/06
(52) Domestic classification F2S 102 111 121 124 125 BD
(56) Documents cited
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(58) Field of search F2S
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(54) Hydraulic energy absorber

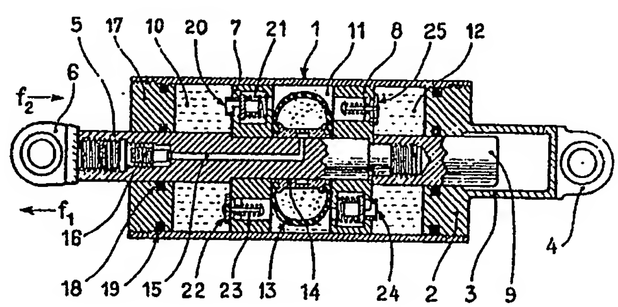
(57) Hydraulic absorber of the energy of a moving mass comprises a cylinder 1 separated into two working chambers 10, 12 by a piston 7, 8 connected to the moving mass; movement of the piston forces a liquid to pass from one working chamber to the other through a narrow passage wherein it is throttled, with conversion of mechanical energy into heat.

The device is filled with liquid, and includes an auxiliary chamber 11 with elastic walls maintaining it under pressure. The auxiliary chamber communicates with at least one of the working chambers 10, 12 through a valve system 20, 22, 25 permitting free passage from the auxiliary chamber to the working chamber but allowing flow in the opposite direction only under the action of high pressure generated in the working chamber.

The invention is applicable to dampers for oscillations of low amplitude, in particular for railway rolling stock.

The auxiliary chamber with elastic wall may instead surround the working chambers.

FIG.1



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half-piston 8 is provided with flap valves and similar valves 25, suitably regulated.

The operation of this dissipater is as follows. When a force is applied on the tab 6 in the direction of extension along the arrow f1, the liquid of the chamber 10 can only escape to the chamber 11 by repelling the flap valve 20 against the spring 21, which opens a passage restricted according to the calibration of the spring 21. It is this calibration which determines, by the pressure drop that it causes, the pressure in the chamber 10, that is to say the reaction or the resistance of the dissipater according to the stroke and the speed of the movement.

From the chamber 11 the liquid then passes freely into the chamber 12, through the valve 25, the two chambers then being at the same reduced pressure which is that at rest. In the reverse direction, on compression along the arrow f2, it is the liquid contained in the chamber 12 which is throttled through the flap valve 24 of the half-piston 8, to the chamber 11 first and then, without resistance through the valve 22, to the chamber 10. Thus the auxiliary chamber 11, between the chambers 10 and 12, is always at an initial low pressure, without undergoing the high pressures generated by the working surfaces of the two half-pistons 7 and 8 bounding the two working chambers 10 and 12. The toric envelope 13 filled with air at low pressure but higher than atmospheric pressure, only undergoes here small variations, due to the thermal expansion of the liquid, under the action of its own heating by the work performed and under the action of the variation in ambient temperature.

The envelope 13 constitutes an elastic wall for the auxiliary chamber 11, which permits the chamber 11 to be maintained constantly full of liquid at low pressure, and thereby also the working chambers 10 and 12. Through this fact, the dissipater can operate effectively, at any moment, in all positions even on the smallest movements and without risk of cavitation or unpriming and this whatever the amount and quality of gases dissolved originally in the liquid.

The dissipater of Figure 2 is also composed of a cylinder 26 closed at its ends in fluid-tight manner by a bottom 27 and a counter-piston 28, in which a hollow rod 29 slides. The rod carries a piston in two parts 30 and 31, which divides the cylinder 26 into two working chambers 32 and 34 and an intermediate auxiliary chamber 33.

In the chamber 33 is a hollow ring 35, of elastic material, such as rubber, for example, filled with air or any other gas at low pressure. A spindle 36, fast to the bottom 27, slides in fluid-tight manner in the hollow rod 29. The half-pistons 30 and 31 are provided respectively with flap valves 37, 38 and with similar valves 39—40 and for filling the same functions as those of Figure 1.

The operation of this absorber is similar to that of the first embodiment, but the ring 35, here has an additional action. In fact, when the device is compressed along the arrow f3, the liquid driven from the chamber 34 cannot entirely pass into the chamber 32 since the latter only increases by a very small volume by reason of the difference in diameter of the rods 29 and 36.

The excess volume of liquid must be able to find space in the auxiliary chamber 33, by compressing the hollow ring 35 which takes the shape 35′ with an increase in its internal pressure.

In the case of pulling on the rod 29, in the direction of the arrow f4, it is the reverse action which occurs. The hollow ring 35 inflates under the action of its internal pressure and drives additional liquid from the chamber 33, through the valve 40, to the chamber 34, whose volume increases faster than that of the chamber 32 diminishes.

In this embodiment the hollow ring 35 permits not only compensation for the variations in volume of the liquid due to variations of internal and ambient temperatures, but also those due to the movements of the rod. Thus the working chambers 32 and 34 are always kept full and ready to operate in all cases and all positions. The spindle 36 which only serves for reducing the volume of liquid to be compensated, could be eliminated in certain cases, for example if the movements are of small amplitude, or if the forces to be damped are small and enable the diameter of the rod 29 to be reduced.

The absorber shown in Figure 3 includes a cylinder 41, in which a single piston 42 moves, fixed to a rod 43, and which divides the inside of the cylinder 41 into two working chambers 44 and 45. An outer tube 46 of larger diameter, forms an annular space with the cylinder 41. An elastic envelope, for example of rubber, is fixed in fluid-tight manner, by its upper edge 48 to the cylinder 41, and by its lower edge 49 to the tube 46, thereby forming two annular chambers 50 and 51. The bottom 52 which closes both the tube 46 and the cylinder 41, causes the working chamber 44 to communicate with the auxiliary chamber 51 through a flap valve with high resistance 53 and, in the reverse direction, through valves 54 constituted by a washer held by a very weak spring. A counter-piston 55 closes the chamber 45 in sealed manner. It is provided with a screw 56 which can serve for the evacuation of the air and for filling with liquid, on mounting. The piston 42 includes, on each of its two surfaces, one or several flap valves 57 and 58, suitably loaded by calibrated springs which determine, as in the preceding embodiments, the respective resistances of the absorber in extension and in compression.

The elastic envelope 47 is preformed to tend to give the auxiliary chamber 51 a minimum volume as shown in interrupted lines in the portion of the Figure, which would correspond to the maximum upper position of the piston 42. In the case of deformation of the envelope, its elasticity will tend to make it resume its initial shape. If necessary, to increase its elasticity, an armature could be provided by metal springs.

On a compressive force, the piston 42 descends and forces a portion of the liquid of the

chamber 44 to the chamber 45, with throttling on the passage of the flap valve 58 and of the throttled orifice which it uncovers. However the volume driven from the chamber 44 is greater than the increase in volume of the chamber 45 on account of the penetration of the rod 45, so that a portion of the liquid must pass into the chamber 51, thereby forcing the opening of the flap valve 53; the elastic envelope 47 expands and takes up the shape 47'. The pressure generated by the elasticity of the envelope 47, and which is exerted on the equivalent of the section of the rod 43, naturally adds its resistance to those given by the flap valves 58 and 53.

In the reverse direction, a pulling force on the rod 43 produces a compression of the liquid in the chamber 45 and a passage of liquid into the chamber 44 with throttling through the narrowed opening offered by the valve 57. To compensate for the withdrawal of the rod 43, an additional amount of liquid passes from the chamber 51 to the chamber 44 through the valve 54. This complementary liquid is not drawn, but thrust by the contraction of the elastic envelope, whence a constant filling of the two working chambers 44 and 45 without suction or cavitation.

The dissipater is then adapted to operate effectively at any time in all positions. It is also obvious that such a dissipater can work also for very small movements and this after very long periods of immobilization, without necessitating any priming whatever.

Of course, the invention is not strictly limited to the embodiments which have been described by way of example, but it also covers constructions which would differ therefrom only in detail, in variations of execution or in the use of equivalent means. Thus it would be possible, instead of rubber envelopes 13, 35 or 47, to constitute an elastic wall of the auxiliary chambers 11, 33 or 51 by means of fluid-tight metal bellows.

There could also be provided, in the version of Figure 3, the use as an auxiliary chamber of all the annular space between the tubes 41 and 46, and by arranging in this annular space one or several hollow rings of the type of that shown at 35 in Figure 2.

In all these embodiments the auxiliary chamber is still at low pressure, and isolated by a flap valve or a throttling of the high pressures generated in the working chambers on an impact applied to the device. However the permanent pressure in the auxiliary chamber, maintained through its elastic wall, permits the constant filling at low pressure of the working chambers to be ensured even in the resting condition; the oil is thus constantly isolated from the air and the release of dissolved gases is rendered practically impossible.

CLAIMS

1. Hydraulic absorber for the energy of a moving mass, of the type constituted by a cylinder containing a liquid and separated into two working chambers by a piston connected to the moving mass, wherein the movement of the piston generates, according to the direction of the movement, a pressure in one of the two working chambers, thus forcing a portion of the liquid to pass into the another chamber through narrow passages where it is throttled with the transformation of mechanical energy into heat, wherein the two working chambers are separated by an intermediate chamber formed within the thickness itself of the piston which is then in two parts each defining one of the working chambers and surrounding the auxiliary chamber, each of the two piston parts comprising at least one flap valve enabling free passage of the liquid only from the auxiliary chamber to the working chamber concerned, and at least one throttled passage with a calibrated flap valve enabling passage with throttling from the working chamber to the auxiliary chamber, and from there to the other working chamber, the device being completely filled with liquid held, even at rest, at a pressure higher than the surrounding pressure by means of an elastic wall of the intermediate chamber.

2. Hydraulic dissipater according to claim 1, wherein the elastic walls of the intermediate chamber are constituted by a flexible envelope, fluid-tight, inflated by gas compressible to a pressure at least equal to the minimum pressure to be maintained in the liquid.

3. Hydraulic dissipater according to claim 1, wherein the elastic walls of the auxiliary chamber are constituted by a fluid-tight metal bellows.

4. Hydraulic dissipater for the energy of a moving mass, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.